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## **Magnetic imaging of spin waves and magnetic phase transitions with nitrogen-vacancy centers in diamond**

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# Propositions

accompanying the dissertation

## **MAGNETIC IMAGING OF SPIN WAVES AND MAGNETIC PHASE TRANSITIONS WITH NITROGEN-VACANCY CENTERS IN DIAMOND**

1. Magnetic imaging based on nitrogen-vacancy (NV) centers in diamond will enable the detection of coherent spin waves in monolayer van der Waals magnets.  
*(Chapter 4 of this thesis)*
2. A key advantage of detecting spin waves using NV centers is the explicit relation between the magnetic fields generated by the spin waves and the NV response, which facilitates a quantitative interpretation of the measured spin-wave signals.  
*(Chapters 4-5 of this thesis)*
3. Probing magnetic fluctuations via single-NV relaxometry enables the extraction of the saturation magnetization of thin-film magnets.  
*(Chapter 6 of this thesis)*
4. The use of statistical methods to characterize spatial correlations provides information regarding global physical quantities, such as the temperature of a phase transition, that are otherwise hard to obtain from local NV measurements.  
*(Chapter 7 of this thesis)*
5. The low efficiency of nanoscale spin-wave transducers is the main obstacle to the development of magnonic circuits competitive with CMOS-based circuits.  
*Mahmoud et al., J. Appl. Phys. 128, 161101 (2020)*
6. While quantum computing attracts most of the public attention reserved for the domain of "quantum technologies", quantum sensors are having a larger technological impact.  
*Degen et al., Rev. Mod. Phys. 89, 035002 (2017)*

7. Reconstructing a 2D current distribution is possible from a map of only one of the magnetic field components. However, using a single component introduces artefacts and edge effects, such that measuring the field along two directions is preferable.  
*Broadway et al., Phys. Rev. App. 14, 024076 (2020)*
  
8. Exploiting non-linear properties of magnetic materials will increase the detection range of NV magnetometry in the few-GHz regime, relaxing the constraint of resonance between the sensed signal and the NV frequency.  
*McCullian et al., Nat. Comm. 11, 5229 (2020)*
  
9. When choosing a PhD position, picking the right supervisor is more important than the right topic, as the former has far more influence on how successful and enjoyable the PhD journey will be.
  
10. On a Friday night, spending time with good friends helps making a Monday deadline more than working toward it.
  
11. Fundamental research should not need the prospect of applications to get published or funded.

*Iacopo Bertelli*  
*Leiden, 31 October 2021*